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OATS
IN THE WESTERN HALF OF THE UNITED STATES

THE oat crop of the western half of the United States constitutes less than one-tenth of the total crop of the country. Oats rank second in importance among the cereals grown in this region, due to the almost complete absence of corn production in many sections. With the development of western agriculture, interest in the oat crop is increasing.

The vast territory west of the ninety-eighth meridian, or geographically the western half of the United States, comprises the Great Plains, the Rocky Mountain and intermountain, and the Pacific areas. Within each several oat sections exist. In both the Great Plains area and the Rocky Mountain and intermountain area, oats are grown both on dry land and under irrigation. In the Pacific area oats are grown from both fall and spring seeding.

Except in the drier sections, higher yields and better quality of oats are produced in the western half of the United States than in any other region. However, high production costs and dangers from unfavorable climatic conditions necessitate the use of adapted varieties and the best cultural methods in growing the crop.

To produce oats profitably in the western half of the United States, the essentials are as follows:

A reasonably fertile soil that is fairly retentive of moisture and well prepared as a seed bed.

Use of the most profitable cropping systems. In dry-land sections oats are most productive when grown on fallow, but usually more profitable in a rotation following corn or other tilled crop. In irrigated sections oats do best when grown in rotations with alfalfa and row crops, such as sugar beets or potatoes. In most sections of the humid Pacific area oats usually are grown as an intermediate crop between row crops and clover or grass, occupying about the same position in rotations as in the humid Eastern States.

Good seed of adapted, high-yielding varieties, properly cleaned and graded, and treated with formaldehyde for smut.

Sowing as early as the land is in condition to work in the spring. Early seeding is extremely important in the Great Plains area, owing to the danger of a moisture deficiency later in the season. In the Willamette Valley of the Pacific area oats are sown in October; in California, November is preferable.

Sowing the seed with a drill, preferably. The rates vary with the section.

Harvesting the crop at the proper time for yield and quality.

Preserving the crop from weathering by proper shocking and stacking.

Care in threshing.

Proper care of straw and grain after threshing.

Directions for the profitable production of oats in the western half of the United States are given in the following pages.

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OATS IN THE WESTERN HALF OF THE UNITED STATES

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IMPORTANCE OF THE CROP

LESS than one-tenth of the annual oat crop of the United States is produced in the western half of the country. Oats, however, constitute the second most important cereal grown in this region. With the development of western agriculture, interest in the crop is increasing. In most of the region where the crop is grown yields and grain quality both are good. The crop is grown primarily to complete rotations and to meet feed requirements for domestic animals on farms. The high nutritive value of oats as feed for horses, dairy cattle, sheep, and growing animals is fully appreciated by stockmen throughout this region. In the almost complete absence of corn production in many sections, oats constitute one of the important concentrated feeds for farm animals. Oat straw also is of considerable value in some sections as roughage for horses and cattle.

OAT AREAS

On the basis of climatic and other environmental factors, the vast territory lying west of the ninety-eighth meridian, or geographically the western half of the United States, may be divided into the Great Plains area, the Rocky Mountain and intermountain area, and the Pacific area. (Fig. 1.)

Within each of these areas there are several oat sections, more or less distinct. In both the Great Plains area and the Rocky Mountain

and intermountain area there are dry-land and irrigated sections. The Great Plains and Pacific areas each contain a rather definite section in which the red-oat varieties are grown almost exclusively. In the Pacific area there are sections in which oats are grown from both fall and spring seeding.

THE GREAT PLAINS AREA

The Great Plains area is that territory lying between the ninety-eighth meridian and the foothills of the Rocky Mountains and extending from Canada to southern Texas. This outlines the territory only in a general way but with reasonable accuracy. This area comprises the western parts of the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, and the eastern portions of Montana, Wyoming,

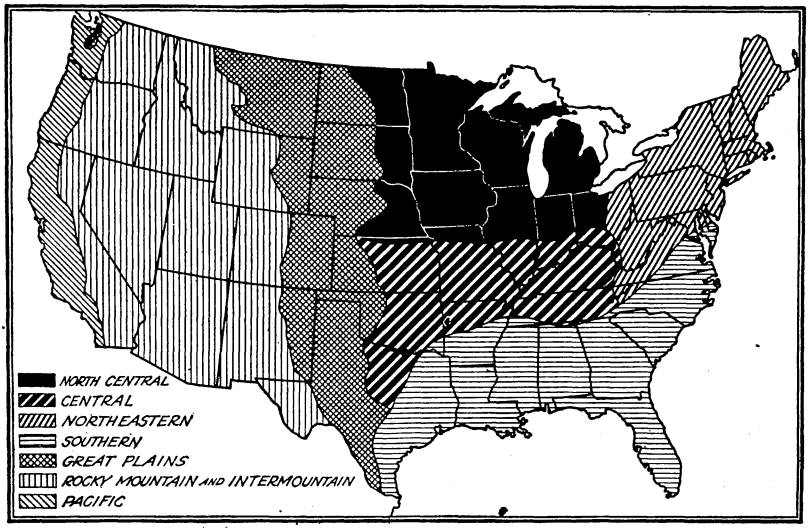

FIGURE 1.—Outline map of the United States, showing the general oat areas. In the southern and Pacific areas the crop is grown from both fall and spring seeding. In all other areas the crop is grown from spring seeding only. The southern area is known also as the winter or fall-sown area. Likewise the central area is often designated as the spring-sown red-oat area

Colorado, and New Mexico. The altitude ranges from slightly below 1,500 to more than 5,000 feet. The topography for the most part is slightly rolling, although great sections are comparatively level. The general outline of the area is shown in Figure 1.

The climate of the Great Plains area is widely fluctuating and rigorous. Crop production in this entire territory is more or less hazardous, and crop failures frequently occur. The rainfall varies widely from season to season, but averages less than 20 inches annually over the greater portion of the area. The distribution of the seasonal precipitation is more often the determining factor in oat production than is total annual precipitation.

The oat crop uses water rather freely and often fails because of drought. In the northern section frosts and even snowstorms occur occasionally early enough in the fall to damage oats before they are harvested, sometimes resulting in severe crop losses. Hailstorms

cause heavy local losses in many sections. In the southern section hot winds are of frequent occurrence in summer and often injure oats and other cereals.

Throughout this area moisture as a rule is the limiting factor in crop production, and as a consequence every possible means should be utilized to store sufficient moisture in the soil to mature a profitable crop. Extensive investigations are being conducted by the Office of Dry-Land Agriculture, Bureau of Plant Industry, United States Department of Agriculture, to determine the most satisfactory rotations to make the growing of oats and other cereals more certain and profitable in this area.

ROCKY MOUNTAIN AND INTERMOUNTAIN AREA

Briefly, the Rocky Mountain and intermountain area includes all the territory extending westward from the eastern foothills of the Rocky Mountains to the western foothills of the Cascade Range and the Sierra Nevada Mountains on the west. It embraces most of the area of the so-called Western Mountain States, including the western parts of Montana, Wyoming, Colorado, New Mexico, and Texas, the whole of Idaho, Utah, Nevada, and Arizona, and the eastern parts of Washington, Oregon, and California. Because of the mountainous character of these States their agriculture naturally is confined to the river valleys, bench lands, and plateaus. In most sections the annual rainfall is relatively low, and where sufficient water is available irrigation farming has been extensively developed. Many of the valleys have been brought under irrigation, resulting in the development of a flourishing agriculture in which oats are an important cereal crop.

In this section oats are grown at elevations varying from 2,000 to more than 6,000 feet above sea level.

In the early development of agriculture in this area oats, wheat, and other crops were grown to some extent under dry-land conditions, and frequent crop failures resulted. With the development of irrigation and an assured water supply for plant growth the culture of oats has increased greatly, and as a result the crop has become of much more importance than formerly. Higher yields are obtained under irrigation in this area than in any other area of the United States. The quality of the oats produced also is unsurpassed.

PACIFIC AREA

The Pacific area embraces a comparatively narrow strip of territory bordering on the Pacific Ocean and extending from Puget Sound in Washington to Lower California. It constitutes an oat area more or less distinct. Owing to the rather generally favorable climate for oats, the crop is grown in some sections from both fall and spring seeding. As a rule, extremes in temperature rarely occur, except in the great interior valleys of California, and usually there is sufficient precipitation for crop production.

Owing to the favorable climate, the production of oats in the Pacific area is greater than the total production for the Rocky Mountain and intermountain area and the Great Plains area combined. In the Puget Sound and Olympic Peninsula sections of Washington oats

are extensively grown, constituting the most important cereal crop. In certain districts of these sections acre yields exceeding 100 bushels are obtained.

In California, oats are grown principally in the central coast district and in the Sacramento and San Joaquin Valleys. Owing to the warm climate of these great interior valleys, oats are less satisfactory than under the cool and more moist conditions of the coast sections. Hot and dry weather during the heading and ripening period frequently is detrimental to the crop. In recent years the unfavorable weather conditions have been offset or neutralized to some extent at least by growing earlier varieties such as Fulghum and Kanota.

SOILS

The soils of a territory as large as the western half of the United States naturally must vary greatly in type, productiveness, and topography.

The soils of the Great Plains area vary from heavy clays to almost pure sands. Most of the land which has been brought under cultivation in this area ranges through the silt loams and clay loams to heavier types. Such soils are fairly well adapted to the production of oats. In some sections the accumulation of alkali in the soil has made crop production almost impossible. Throughout this area moisture rather than fertility or texture is more frequently the limiting factor in crop production. Successful production of oats depends largely upon the ability of these soils to retain moisture and their proper handling for its conservation.

In the Rocky Mountain and intermountain area most of the alluvial river valley soils are well adapted to oats. The soils of river bench lands and uplands of this area are mostly silt or very fine sandy loams, and they produce excellent crops of oats when sufficient moisture is available either through natural rainfall or irrigation. Porous, gravelly soils, under either irrigation or dry farming, are least satisfactory for oats, owing to their poor water-holding capacity.

The silt and clay loams of the Pacific area, particularly those of western Oregon and Washington, are capable of producing excellent crops of oats. The greater rainfall and lower summer temperatures, rather than a difference in soils, make conditions generally more satisfactory for oats than they are outside of irrigated sections in the two areas previously mentioned.

MANURES AND FERTILIZERS

In general, the arable soils of the Great Plains have shown little decrease in fertility since being brought under cultivation. A considerable quantity of readily available plant food usually is present in these soils. Deficient rainfall and frequent light crops have reduced soil fertility less rapidly than in sections where rainfall is more abundant and where larger crops draw more heavily on the soil. Under the latter conditions there also is greater loss by leaching and erosion.

In the Great Plains commercial fertilizers are not necessary. Even barnyard manure seldom is used. Heavy applications of manure are

likely to cause heavy early growth and final loss from crop burning. If manure is used it should be spread lightly to obtain benefit without injury.

In the Rocky Mountain and intermountain area, as in the Great Plains area, practically no commercial fertilizer is used on oats or other cereal crops. Barnyard manure is not used under dry-land farming for reasons similar to those given for the Great Plains. Under irrigation, manure is applied to some other crop in the rotation. On some of the older irrigated soils where heavy cropping is rapidly decreasing native fertility, light applications of manure, if available, can be made with profit. Under irrigation, however, oats make a rank growth and may lodge. It seldom is advisable to apply manure directly to oats.

In some sections of the Pacific area which have been farmed for many years, as for example the Willamette Valley, commercial fertilizers may pay. Barnyard manure should be applied to some other crop in the rotation, such as corn, kale, or potatoes, increased yields of oats being obtained as a residual effect.

Commercial fertilizers, while still little used in this area, should prove profitable in oat production on the soils of the longer settled sections. Ordinarily, where commercial fertilizers pay, an application of 150 to 200 pounds per acre of superphosphate (acid phosphate) is one of the best treatments for oats. Under some conditions a complete fertilizer—that is, one containing phosphorus, nitrogen, and potassium (potash)—may be more satisfactory. Commercial fertilizers, however, should be used in this area only when there is some assurance of a return on the investment.

ROTATIONS

The discussion of rotations under dry-land and irrigated conditions is more or less applicable to both the Great Plains and the Rocky Mountain and intermountain area. Under dry-land conditions the major factor in any rotation is the proper conservation of the limited precipitation as available soil moisture for the crop. Under irrigated conditions, with an abundant water supply, crop rotation is of less importance from this standpoint.

DRY-LAND SECTIONS

Dry-land farming is associated largely with the Great Plains area, yet it is followed to a considerable extent in the Rocky Mountain and intermountain area on bench lands and high plateaus which can not be irrigated. In reality, dry-land farming originated in the latter area and spread thence to the Great Plains. The methods of farming in both sections, therefore, are similar. The fallow system is largely followed under dry-farming conditions. In some sections the land is fallowed one year and cropped to some small grain, usually wheat, the next. In other sections two annual crops are grown after one year of fallow. In still other sections small grains and corn or potatoes are grown in alternate seasons. As a consequence, less oats are grown in the Great Plains area than in the areas to the east.

Results of extensive investigations in rotation methods conducted by the Office of Dry-Land Agriculture, Bureau of Plant Industry, United States Department of Agriculture, indicate that oats, like wheat, are most productive when grown on fallow. However, fallow may not be the most profitable method of production. Crop-rotation plots at the Dickinson Substation, Dickinson, N. Dak., are shown in Figure 2.

The Great Plains area extends over so wide a territory that a rotation especially suitable for one section may not be the best for another. Regardless of the rotation, oats will yield much better on the average in the northern than in the southern part of the area. As a crop, oats use more water to produce a pound of dry matter than does any other cereal. As a consequence, they must be sown early in the spring for best results. This requires that they follow a crop which leaves the soil in such condition that it can be quickly prepared for spring seeding. As in sections farther east, oats follow corn more successfully than any other crop. As oats do not draw

FIGURE 2.—Crop rotation experimental plots at the Dickinson Substation, Dickinson, N. Dak., in 1923

heavily on soil fertility, wheat can be grown after oats with good results. In the central part of the Great Plains area a popular rotation is the growing of corn and small grains in alternate years. This rotation probably gives the greatest return for the least expenditure of labor of any followed in this area.

In the southern part of the Great Plains area grain sorghum replaces corn, but the rotation otherwise is much the same as in the corn-producing sections. In western Oklahoma and Texas some oats are grown in rotation with cotton.

In the northern part of the Great Plains area oats often follow wheat. Oats sometimes are grown to give the soil a change from continuous wheat farming. Next to corn ground, wheatland, especially when spring plowed, apparently is one of the best for oats in the Great Plains area.

In some sections of the Great Plains oats are used as a cover crop for sweetclover or bromegrass sown in the spring. The oats are removed from the ground early enough to permit the sweetclover or grass to make a fair growth in the late summer and early fall.

The cropping systems used on the dry lands of much of the Rocky Mountain and intermountain area are similar to those already described for the Great Plains. The substitution of corn, field peas, alfalfa, etc., for fallow is less common in this area. As a consequence, oats are grown on fallow in the Rocky Mountain and intermountain area more frequently than in the Great Plains area.

IRRIGATED SECTIONS

In irrigated sections grain crops often are the first crops sown on new land. They are the easiest crops to grow immediately after clearing and leveling the land. Irrigated farming, as a rule, is intensive farming, while cereal production is not generally so considered. Cereals generally are the least profitable crops to grow on well-leveled, highly productive, irrigated land. The oat crop is less profitable than wheat, and oats are not used in rotations under irrigation so often as wheat.

Rotations which are followed in irrigated areas in Colorado [1] and Idaho [2] include the following: Alfalfa, three years or more; sugar beets or potatoes two or three years; and cereal crops for two or three years, the cereal being used as a nurse crop for alfalfa in the last year. In another rotation clover instead of alfalfa is grown for two years, beets or potatoes for two years, and a cereal crop one year. The land is then cropped to clover again. In Utah a cereal crop often is used following alfalfa in the rotation.

HUMID SECTIONS

In the Pacific area crop rotation is more diversified than in either the Great Plains area or the Rocky Mountain and intermountain area. Here a greater number of crops are grown, and oats occupy about the same position in rotations as in the humid Eastern States. Oats frequently are sown as an intermediate crop between row crops and clover. A common rotation for this area is a row crop, such as corn or potatoes, followed by oats and clover each one year. Where vegetables are grown for the production of seed, or other special row crops are produced, oats frequently are used as an intermediate crop for seeding to clover. In California less attention is given to crop rotation than in western Oregon and Washington. Where oats are grown in this section they usually are included in rotations along with wheat and barley.

Oats are less influenced by the preceding crop than are wheat or barley. For this reason most rotations are arranged to meet the special requirements of other crops, oats usually occupying the less-favored position. The adaptability of oats gives the crop a flexibility that allows it to work well in almost any rotation.

SEED-BED PREPARATION

In the following paragraphs methods of seed-bed preparation under dry-land, irrigated, and humid conditions are treated separately. Both on dry land and under irrigation special methods are required.

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[1] CARLETON, M. A. THE SMALL GRAINS. P. 423. New York. 1916.
[2] AICHER, L. C. GROWING IRRIGATED GRAIN IN SOUTHERN IDAHO. U. S. Dept. Agr. Farmers' Bul. 1103, 28 p., illus. 1920.

DRY-LAND CONDITIONS

With the exception of being grown after fallow, oats are grown most successfully following a row crop. Corn or sorghum leaves the soil in comparatively good condition to be prepared for oats. As these are row crops, the soil has been cultivated during the previous year and usually is less infested with weed seed than when it has been cropped to small grain. A seed bed also can be prepared with a minimum of tillage expense.

A common practice in preparing corn or sorghum ground for oats is first to break down the stalks or stubble. This can be done best by dragging a heavy pole or an iron rail across the field in the winter, when the ground is frozen. If the ground is frozen, the stalks will snap off much more readily than when temperatures are higher and the soil is soft. A stalk cutter also may be used to reduce the

FIGURE 3.—Preparing a seed bed on dry land with a duck-foot cultivator

stalks. It is not necessary to rake and burn the stalks. The organic material added by a crop of stalks usually is beneficial even in the Great Plains area. Any organic material is useful in checking soil blowing.

After the stalks have been broken the ground may be prepared by disking. Usually it is necessary to double disk the ground in order to break up the soil held by the corn or sorghum roots. The land also may be prepared with a duck-foot cultivator, an implement which is becoming very popular under dry-land conditions. (Fig. 3.)

Oats usually give the best results if the seed bed is composed of not more than 3 to 4 inches of loose soil on the surface and is firm beneath. This condition usually can be obtained by disking the ground twice. A very satisfactory method is to lap disk the ground; that is, to lap half on each round. This leaves the ground more nearly level than if it is cross disked. The disks should be sharp to insure cutting the stalks. The disks should be set to penetrate the soil 3 to 4 inches. The tandem disk is being used more and more in this area for preparing the seed bed for oats and other small grains. After disking, the ground may be leveled with a spike-tooth or other

smoothing harrow. In Figure 4 is shown a disk harrow being used to level land which had been ridged to prevent soil blowing.

Although it is a more expensive method of preparing the soil, experiments conducted at several of the field stations of the United States Department of Agriculture in the Great Plains area have shown that oats will produce better yields if sown on spring-plowed land. However, this usually is too expensive a method of preparing the seed bed to be practicable for oat growing in this area.

IRRIGATED CONDITIONS

On land previously cropped and already comparatively level, a good seed bed for oats can be prepared by fall plowing the land and leaving it rough over winter. The natural lumps resist soil blowing to a considerable extent. Land that is spring plowed can be worked

FIGURE 4.—Disk harrow being used in the Great Plains area to level land which had been ridged to prevent soil blowing

down sufficiently for a good seed bed, but it requires considerable packing. This can be done by using land rollers, packers, or even a disk harrow, the disks of which are set straight. Usually it is well to level irrigated land each season with a float or drag. This operation helps to keep the surface from becoming uneven after washing by irrigation water or rains.

HUMID CONDITIONS

In the Pacific area methods of seed-bed preparation are similar to those followed in the North-Central and Northeastern States. Where oats follow corn, potatoes, or some special row crop, such as vegetables for seed production, a satisfactory seed bed usually can be prepared by disking. Plowing usually is necessary where oats follow wheat or barley. To plow the land in the fall and leave it unharrowed over winter is a common practice. Early spring plowing sometimes is practiced because of less danger of loss from soil erosion. Ordinarily fall-plowed land may be fitted for oats with the minimum of disking and harrowing. In this area, as in all others, the best seed bed for oats is one that is firm beneath, with a fine mellow top layer of soil from 2 to 4 inches deep. Methods which will produce these conditions are to be recommended.

PREPARING THE SEED FOR SOWING

CLEANING THE SEED

Oats usually are threshed with an air blast weaker than that for other cereals, because of the danger of blowing the lighter oats away. As a result oats often contain a considerable proportion of trash and weed seed. These impurities should be removed from seed oats.

In fanning and grading the seed the openings in the screens should be sufficiently large to let all small weed seed fall through but not large enough to allow any but the smallest of the oat kernels to pass. The larger weed seed and trash can be separated from the oats by first using a screen with meshes sufficiently large to let the oats pass through but small enough to catch sticks, pieces of straw, etc. Grading seed oats to the point where only the larger and plumper kernels remain is not necessary.

SEED TREATMENT FOR SMUT CONTROL

THE SPRAY METHOD

Place the seed on a clean barn floor or canvas spread on the ground, or in a tight wagon box or header barge. Mix 1 pound of formaldehyde (37 per cent by weight) with 1 pint of water and pour the solution into a quart pump sprayer. Then shovel the oats from one pile to another, spraying each shovelful. One stroke of the sprayer piston should produce sufficient mist for the seed on an ordinary dirt shovel, or four strokes for the seed on a scoop shovel. After the oats are sprayed, shovel them into a pile and cover with blankets, tarpaulins, or sacks which also have been sprayed with the solution. The pile of seed should remain covered at least five hours and may be left overnight without injury. The oats are then ready for bagging and drilling. However, if sowing is delayed, or if it is planned to store the oats for some little time, the pile should be spread out and thoroughly aired for a day or two.

A modification of this method is sometimes used. This is done by mixing 1 pound of formaldehyde with 10 pints of water. The treatment is conducted in the same manner as for the 50-50 solution, except that a heavier mist is applied to the seed. In using any of the spraying methods care must be exercised to prevent irritation of the eyes, nose, and throat by the formaldehyde vapor.

THE SPRINKLE METHOD

The oats are placed in a pile on a clean barn floor or canvas. As the grain is shoveled from one pile to another it is thoroughly sprinkled with a solution made up of 1 pint of formaldehyde (37 per cent by weight) to 40 gallons of water. After the sprinkling has been completed and it is assured that every kernel is wet, the oats should be covered with blankets, sacks, or canvas, disinfected in the same solution, and allowed to remain for at least two hours, or overnight. The sacks should then be removed and the seed spread out to dry, or the oats may be sown immediately on removing the cover. About one-fourth more seed by bulk should be sown to the acre to allow for the swollen condition of the seed.

THE DIP METHOD

Seed oats may be treated also by dipping them directly in the solution. The solution, which is made up the same as for the sprinkle method, is placed in a barrel. The oats are put in burlap bags, which should be neither packed too tightly nor filled too full. The bags are dipped into the solution in the barrel and allowed to remain for several minutes, or until all of the grain is wet. The sack should be moved about somewhat while immersed in the solution, in order to hasten wetting the grain. A good method of agitating the seed is to roll it from one end of the sack to the other. After treatment the sacks should be lifted out and drained on a board laid across the top of the barrel. After draining for a few minutes the oats are poured out of the sack on a clean floor or in a wagon box and handled thereafter in the same manner as in the sprinkle method.

In order to prevent reinfection after treatment, care should be taken to disinfect the bins, sacks, or wagon boxes in which the seed is stored before sowing and the drill box and feed spouts through which the seed is sown. This can be done by spraying them with some of the formaldehyde solution.

Surplus seed treated with formaldehyde may be fed to livestock without injury if thoroughly dried after treatment. By exposing it to the open air for several days all danger will be avoided.

For more complete information on seed treatment of oats for the control of smuts, see Miscellaneous Publication No. 21.[3]

SEEDING OATS

METHODS OF SOWING THE SEED

GREAT PLAINS AREA

Although oats may be sown either by broadcasting or with a drill, the latter method is used almost exclusively in the Great Plains area. Power machinery is much used in this area, and it is not uncommon to see several drills being pulled by a single tractor. This hastens the seeding operation, a very important consideration in growing oats in any section. This is especially true in the Great Plains area, where moisture is likely to be deficient later in the season and early seeding is a very important consideration.

ROCKY MOUNTAIN AND INTERMOUNTAIN AREA

In most irrigated sections of this area the acreage devoted to any one crop is small, yet it has been learned from the experience of the most successful farmers that the sowing of cereals is best done with the drill. Some grain still is sown broadcast, but within recent years the drill has come into more general use, and drilling usually is the method recommended.

PACIFIC AREA

In the Pacific area the drilling of oats is largely practiced, although earlier seeding sometimes can be done by broadcasting.

Under any conditions, drilling permits the seed to be scattered more uniformly than by broadcasting. The seed also is covered at a more uniform depth and usually is placed in moist earth where conditions for germination are more favorable than when the seed is broadcast on the surface and a second operation depended upon for covering. The placing of the seed in moist earth is more necessary under dry-land than under irrigated or humid conditions.

The rate at which oats should be sown will vary with the locality, the date of seeding, the condition and fertility of the seed bed, the purpose for which the crop is intended, the method of seeding, and kernel size. Ordinarily, a slightly heavier rate is used where seeding has been delayed beyond the usual time and less time for tillering remains. On soils likely to become weedy, more seed should be used than on clean soil. Slightly more seed also should be sown on a poorly prepared seed bed. In drilling, less seed is required than

[3] TAPKE, V. F. FORMALDEHYDE SEED TREATMENT FOR OAT SMUTS. U. S. Dept. Agr. Misc. Pub. 21, 4 p., illus. 1928. (Rev. 1929.)

SEEDING RATES

when it is sown broadcast. This is because of a greater likelihood of incomplete covering in broadcasting. If the crop is intended for hay or pasture it may be sown at a rate heavier than when it is to be harvested for grain. Where varieties have comparatively large kernels they may be sown at heavier rates than the smaller-kerneled varieties in order to obtain an equal number of plants to a given area. Many experiments have been conducted by the United States Department of Agriculture in the Great Plains area to determine the best rate to seed oats. The results of these experiments seem to indicate that tillering depends very largely on the number of plants to the acre. If the stand is thin usually more tillering will result than if a heavy stand exists, although seasonal climatic conditions may influence tillering to a marked degree. Most often oats are sown in the Great Plains area at rates varying from 4 to 8 pecks per acre, 5 or 6 pecks being the most common rates. The rates of seeding oats in this section usually are not so heavy as in sections farther east, where the rainfall is greater and less danger of drought exists.

In irrigated sections it is essential that good stands of oats be obtained. This is especially true because of the expense of growing the crop and the comparatively small value of the return it makes. One reason for thick seeding is the elimination of weeds. Some farmers cross drill their land. The distance between the drill rows also is a point of controversy, but as yet no information is available to show that so-called close drilling in rows 4 inches apart has an advantage over the usual drilling in rows 6 to 8 inches apart.

It has been found, however, that where oats are used as a nurse crop for alfalfa or clover they should not be sown too thickly. The oats are likely to choke out the alfalfa or clover. The seeding rate for oats in the irrigated sections varies from 8 to 12 pecks per acre. The average rate is about 10 pecks. When oats are used as a nurse crop the seeding rate ordinarily should be reduced by at least one-fourth.

In the Pacific area the usual rates of seeding are from 10 to 12 pecks per acre, although under the very favorable conditions for oats in western Washington and Oregon, they are sometimes sown at rates of 14 or even 16 pecks per acre. In California the best rate for red oats is about 10 pecks.

DATE OF SEEDING

One of the most important requirements in oat production in any area is that the seed should be sown early in the spring. In the Great Plains area early seeding is extremely important. As a rule, the danger of loss from seeding too early is less than from seeding too late. The injury resulting from late freezes occurring after the seed is sown and some growth has started is less than that from seeding later in the season because of the increased likelihood of hot and dry weather during critical stages of the crop's growth.

The Great Plains area extends over so great an expanse of territory from north to south, as well as from east to west, that the seeding dates necessarily vary considerably. For the entire area the best general recommendation is the earliest possible date in the spring when the ground is in a condition to be prepared satisfactorily and

after danger of prolonged cold or of zero weather is past. Cases are on record in the Great Plains area where subzero weather has occurred after oats have been sown and yet little injury resulted.

Most irrigated districts are located at elevations which are comparatively high. As a result, in most of the districts the growing seasons are short and there is danger from early fall frosts if the grain is sown too late. Oats should be sown as early in the spring as possible in irrigated sections as well as on dry farms. Late seeding is not recommended, as in most seasons a decided reduction in yield will result.

In the Pacific area there is great variation in the time of seeding. In western Oregon and Washington most oats are sown as early in the spring as possible. The first week in April is about the average date of seeding for these districts. In the Willamette Valley some oats are sown in the fall, usually during October. In California, oats may be sown at any time from October 15 to February 15. Ordinarily most oats in California are sown in November. Farm practice indicates that the best results usually are obtained by seeding at this time. If sown later, the crop will have less opportunity to escape heat and drought during the ripening period.

CULTIVATION OF OATS

HARROWING

The yield of oats sometimes may be increased by cultivation when the plants are well through the ground. More often such cultivation is not practicable. On irrigated land where the soil is rather loose and cloddy and likely to dry out rapidly, a float or land roller is used sometimes after seeding to firm the soil and make a smoother seed bed. Sometimes an oat field is harrowed in the spring to destroy weeds. Where small weeds are numerous in the crop before the oat plants fully shade the soil, the field may be given a light harrowing with a spike-tooth harrow. This will destroy many small weeds and may pay if it does not injure the oats. To prevent the harrow from damaging the oat plants, the teeth should be thrown back at an angle in order to stir the minimum of surface soil and to destroy the maximum number of small weeds.

WEEDING

Some farmers follow the practice of cutting or pulling large weeds, such as mustard and sunflowers, from their oat fields in order to prevent them from producing seed or interfering with cutting and shocking operations. Some oats will be trampled down in the operation, particularly if the weeds are not removed until late in the growing season, but the grain lost in this way probably will be more than compensated for by the eradication of noxious weeds. Spraying to kill weeds in oats is impracticable.

For information on irrigation of oats and other small grains, including directions on time to irrigate and the quantity of water to apply, see Farmers' Bulletin No. 1556.[4]

[4] McLAUGHLIN, W. W. IRRIGATION OF SMALL GRAIN. U. S. Dept. Agr. Farmers' Bul. 1556, 14 p., illus. 1928.

HARVESTING THE CROP

CUTTING

In the Great Plains area most of the oats have been harvested with the binder. In some portions of this area the header also has been used. More recently the header has been partly replaced by the combine (combined harvester-thresher). Sometimes oats in this territory are cut with a mower. This method is used when the plants are extremely short, on account of heat or drought or severe hail or wind injury, or in cases where so much lodging has occurred that the binder can not be used. Oats sometimes are mowed while yet a trifle green, the object being to feed them in the straw without threshing. If cut in this way the grain may be raked into windrows and later

FIGURE 5.—An unusually good crop of oats in shock in the Great Plains area

placed in cocks. When handled in this way the grain should be cut before it becomes too ripe, or there may be some loss through shattering. A field of excellent oats in shock in the Grain Plains area is shown in Figure 5.

The method of cutting may determine the stage at which to harvest the crop. If the grain is cut with the binder or the mower, it should be cut very soon after the crop reaches the stiff-dough stage. If the header is used, oats should be cut while in the late-dough stage; but when the combine is used the grain should be allowed to stand until ripe and dry enough to store without danger of loss from heating and moulding in the bin. If there is danger of the grain spoiling after being harvested with a combine it should be spread out on a granary or barn floor to dry. It is common practice in the Great Plains area to spread grain which has been threshed with a combine directly on the ground in the open, often without any protective covering. Usually the loss from this method is not great.

Nearly all oats grown under irrigation are cut with the binder. After the oat kernels in the upper part of the panicle have passed the hard-dough stage the crop is ready for harvest. Irrigated oats should not be cut too soon, in order to obtain full use of available moisture. If the grain is badly lodged, it may be necessary to cut only one way of the field, or even to cut the lodged areas with a

mower or by hand with a scythe or cradle. These latter methods are likely to cause considerable loss from shattering. The combine has spread rapidly in other parts of the country and it may have a place in irrigated sections. The small area of the grainfields, however, and the difficulty of crossing dikes and ditches with large machines make the combine less adaptable to irrigated lands. Harvesting irrigated oats with a binder is shown in Figure 6.

SHOCKING

In the Great Plains area and the Rocky Mountain and intermountain area oats should be shocked as quickly as possible after being cut with a binder. The atmosphere here usually is so dry that shattering is liable to result if the grain is allowed to dry out too

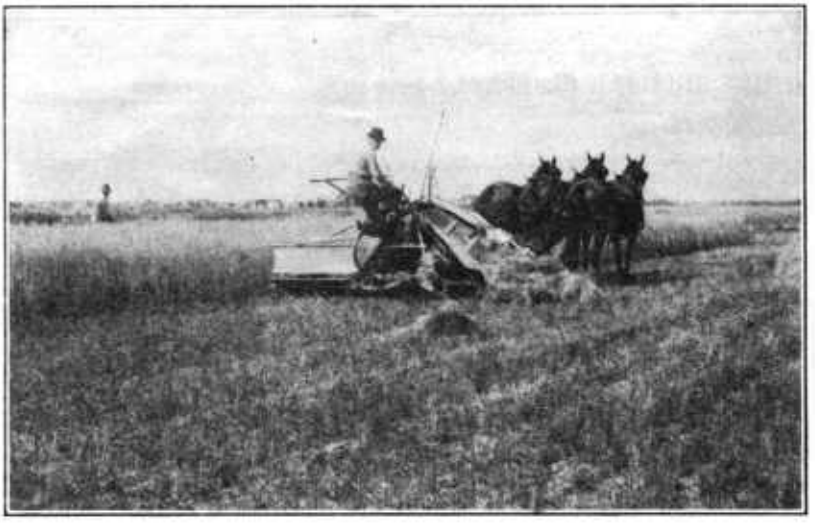

FIGURE 6.—Harvesting irrigated oats with a binder

much or to become thoroughly ripe before being cut and placed in shocks. In both these areas oats usually are shocked in round shocks. Winds are prevalent, and the long shock seldom is used because of the greater danger of its being blown down. Regardless of type, special attention to proper shocking will insure maximum protection from the weather and a better quality of grain.

In the Great Plains area and the Rocky Mountain and intermountain area, as well as in the Pacific area, cap sheaves seldom are used because usually they are blown off by high winds. Greater damage results from their coming in contact with the soil than would result from leaving the shock uncapped. There also usually is no special need of caps, as rain seldom causes much damage during the harvest season. Shocked oats grown under irrigation in Oregon are shown in Figure 7.

STACKING

Oats in the western United States usually are not stacked but are threshed directly from the shock.

In stacking oats under any conditions, whether cut with the binder, header, or mower, it is advisable that the stack ground be well drained. Some farmers follow the practice of plowing the ground and scraping a small mound on which to place their stacks. This practice insures a well-drained stack bottom. In the Great Plains area rainfall seldom is so great as to require the same attention to this phase of stacking as is essential in sections of greater rainfall and humidity. In the Rocky Mountain and intermountain area stacks should be placed where there is no danger of overflow water from irrigation soaking the bottom of the stacks.

It is well to cover the ground with straw, fence posts, or poles to prevent the grain from coming in contact with the soil. Oats usually are stacked in round stacks, although long ricks are sometimes used. Headed grain usually is stacked in rather long, narrow ricks brought

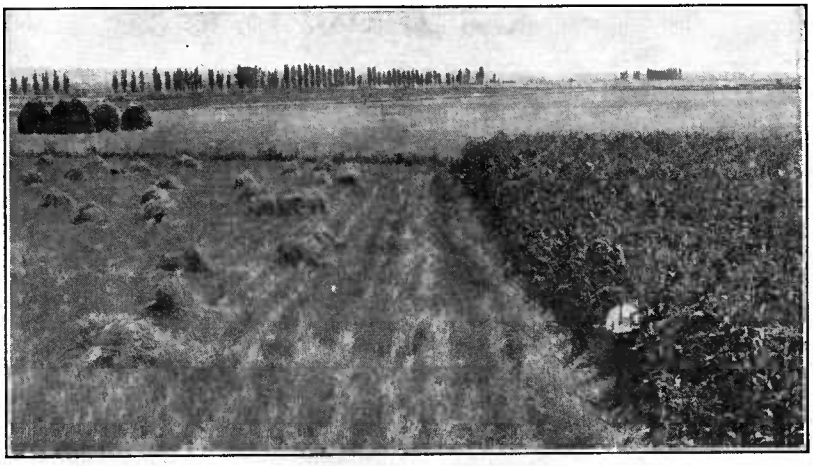

FIGURE 7.—A field of harvested oats grown under irrigation in Oregon; wheat in stack in background at left and corn in foreground at right

to a sharp point in topping. All grain at time of stacking always should be as dry as possible to prevent heating and damage from stack burn.

In building up the stack to the height of the bulge, the middle always should be kept full and well tramped. The other rows of bundles should be tramped as little as possible. Likewise, in building the top of the stack, the middle should be kept high and well tramped at all times. Attention to these essentials will insure a distinct downward slope of the straws in the exposed butts of the outer bundles, which is necessary if the stack is to shed water perfectly.

There is much less danger of grain spoiling in the stack in the Great Plains area than in more humid sections. It usually is not advisable to thatch grain stacks with straw or hay to prevent spoiling, although thatching will prevent damage by birds, which seem to be especially fond of oats.

THRESHING

Although in the Great Plains area and the Rocky Mountain and intermountain area the danger of oats being too wet for threshing

is not great, it is essential that oats be thoroughly dry before they are threshed. When grain is not dry it is likely to heat and mold in storage. In threshing wet grain the operation is performed less efficiently than when the grain is dry. The danger of delays caused by the clogging of the machinery, the throwing of belts, and by breakdowns is much greater when the grain is wet than when it is dry.

It is very important that the threshing machine should be thoroughly cleaned before starting. It is recognized that noxious weeds, such as fan weed, dodder, morning-glory, and Canada thistle, as well as plant diseases, especially smut of wheat and oats, may be scattered from farm to farm by failure to clean the threshing machine properly after each setting. An oat-threshing scene in western Washington is shown in Figure 8.

Oat straw is superior to the straw of all other cereals as roughage for livestock. West of the ninety-eighth meridian, where the hay crop is often short, it is customary to save oat straw for feeding. If

FIGURE 8.—Threshing oats in Skagit County, Wash.

space is available it is well to store the oat straw under cover at threshing time. If stored outside it should be carefully stacked to avoid injury from the weather.

VARIETIES

There naturally is a great deal of variation in the adaptability of oat varieties in so large a territory as the entire western half of the United States. The adaptation of varieties not only differs markedly for each area, but there also is a marked difference in the adaptation within each of these various areas. Generally in the Great Plains area early varieties have been most satisfactory. In the southern section of the Great Plains early red varieties usually are recommended. In the central section early (common) varieties and in the extreme northern section midseason white oats produce the highest yields. Generally, in the Rocky Mountain and intermountain area varieties maturing in midseason under irrigated conditions are the most productive. With an abundance of water the larger and later varieties are decidedly more productive than the earlier, shorter-strawed sorts for growing under irrigation. The longer growing

period enables them to use the abundant water supply more advantageously. In the Pacific area there is a still wider variation in the adaptation of varieties. Both fall-sown and spring-sown varieties are grown in western Oregon and Washington. For fall seeding the Winter Turf (Oregon Gray Winter) variety is the most productive. Midseason and late varieties usually are recommended for spring seeding. In California oats may be sown from November to February. In that section the varieties at all well adapted are limited almost entirely to those of the Red Rustproof and Fulghum groups.

VARIETIES FOR THE GREAT PLAINS AREA

Comparatively few varieties of oats are grown in the Great Plains area. Except in the extreme northern part, early oats are decidedly the most satisfactory under the dry climate of this area. The introduction of the early, short-strawed, drought-escaping varieties, Kherson and Sixty-Day, from Russia at the beginning of the present century resulted in making oats a much more certain crop in the Great Plains area. The development of the Fulghum variety also has been a stimulation to oat production in this area, especially in the southern section. The Great Plains may be divided as follows: Southern section, early red oats almost exclusively; central section, early common oats with some early red varieties; and northern section, early and some midseason common oats.

RED OAT VARIETIES

The principal varieties of red oats are Red Rustproof, Fulghum, and Burt. Owing to the later maturity of the Red Rustproof and its various strains, this variety is not especially well adapted to the southern Great Plains. The early varieties, Fulghum and Burt, are the best adapted of all varieties and are to be recommended. Prior to the development of the Fulghum variety, Burt was the leading variety. In recent years Kanota, a strain of the Fulghum, has become of importance and is now by far the most popular variety.

The Fulghum is an early red oat with a small, rather erect panicle. Under dry-land conditions this variety has shown superiority over both the Red Rustproof and Burt varieties. It is possible that by selection still more satisfactory strains can be developed from the Fulghum and possibly from the Burt variety for extremely dry conditions in this section.

EARLY AND MIDSEASON VARIETIES

For the central Great Plains, early varieties such as Kherson and Sixty-Day, including various selections from them, are the most satisfactory, although in many localities Fulghum and its strains also do well. The results of experiments conducted in this area show that the improved strains of Kherson, such as Richland, Albion, Iowar, and Nebraska No. 21, have yielded as well as, or better than, the parent variety. (Fig. 9.) These early maturing, short-strawed, small-kerneled oats apparently are able to produce much more satisfactory yields with limited rainfall than the larger kerneled, taller strawed midseason varieties, such as Silvermine, Swedish Select, and Victory.

In the northern section of the Great Plains area midseason varieties, such as Silvermine, Banner, Lincoln, and Victory, frequently are preferable to the early sorts. In many districts in this northern portion the Kherson strains also do well and sometimes are grown. In this northern area a choice may be made between the midseason

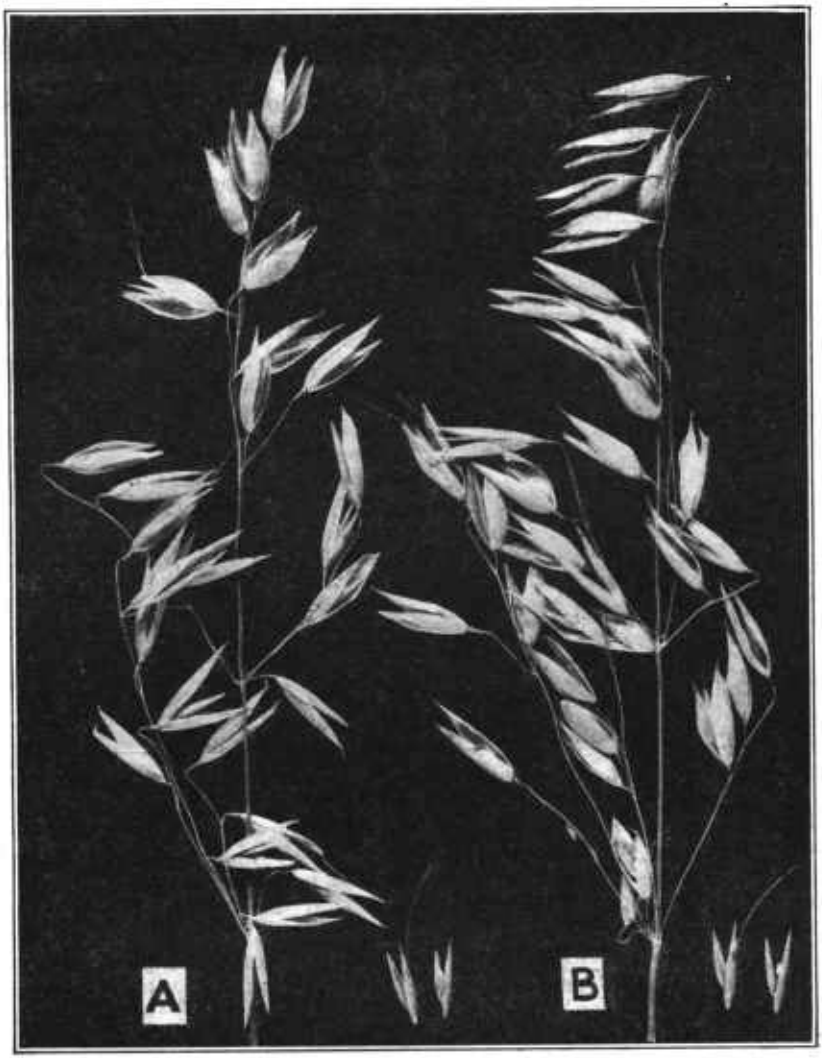

FIGURE 9.—Panicles of Kherson (A) and Richland (B) oats, early short-strawed varieties well adapted for growing in the Great Plains area

or early varieties. If spring conditions are adverse and make seeding impossible at the most favorable time, an earlier maturing variety may be sown at a later date.

VARIETIES FOR THE ROCKY MOUNTAIN AND INTERMOUNTAIN AREA

As previously mentioned, varieties maturing in midseason are mostly grown in this area, especially under irrigation, since they can

fully utilize the abundant water supply. Many early varieties have been grown in comparative experiments throughout this area, but in most seasons they have been exceeded in yield by the later and larger varieties. Only in exceptional seasons is the reverse true, that is, in seasons when water is short or hail damages the crop. Among the varieties which are grown under irrigation may be named Silvermine, Lincoln, Swedish Select, Banner, and Victory. The three most important selections or improved sorts of this group are Colorado No. 37, Idamine, and Markton.

Colorado No. 37 was developed by the Colorado Agricultural Experiment Station as a selection from the Swedish Select variety. It is not quite so tall and has fewer awns than that variety. It is rather extensively grown in Colorado and to some extent in Utah as an irrigated crop.

FIGURE 10.—A field of excellent oats of the Victory variety in Skagit County, Wash.

Idamine is a selection from a commercial strain of Silvermine, known as Funk, made at the Aberdeen (Idaho) Substation. It is a typical strain of Silvermine, but possesses a whiter kernel than most selections of that variety. Its distribution has been confined principally to southern Idaho.

Markton was developed at the Sherman County (Oreg.) Branch Experiment Station as a selection from an unnamed oat originally brought from Turkey. It is a very productive early to midseason variety, highly resistant to or immune from the smuts of oats. This new variety has become of considerable commercial importance in eastern Washington and Oregon, northern Idaho, and adjacent Montana. Its place as an irrigated oat remains to be determined, however.

The White Tartar (White Russian), a late side oat, frequently is grown under irrigation. This variety is decidedly inferior to most of the midseason varieties previously mentioned. Golden Rain, a yellow-seeded, very tall, midseason oat, has been one of the most productive varieties grown under irrigation. Where oats are grown

primarily for feed on the irrigated farm the yellow kernels of Golden Rain are not objectionable.

VARIETIES FOR THE PACIFIC AREA

VARIETIES FOR WESTERN OREGON AND WASHINGTON

For spring seeding in Oregon and Washington midseason varieties, such as Abundance, Swedish Select, Silvermine, Banner, Markton, and Victory, are grown for the most part. Of these, Abundance, Banner, and Victory probably are most extensively grown. The cool climate and rather generally favorable conditions have made these slightly later maturing sorts the most productive. A field of Victory oats in western Washington is shown in Figure 10. In recent years

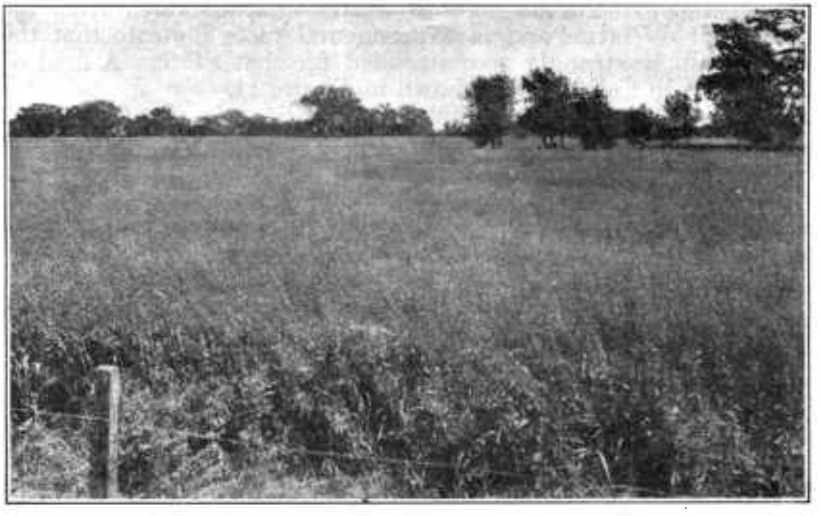

FIGURE 11.—A field of Fulghum oats about ready for harvest near Davis, Calif.

the Markton variety has come into commercial production. It is attracting interest because of its high-yielding ability and its freedom from the smuts of oats.

Such late side-oat varieties as White Tartar and Sparrowbill are grown to some extent in a few sections. The inherent lower yielding power of these varieties makes them less satisfactory than the midseason sorts previously mentioned.

As in the Rocky Mountain and intermountain area, early oats are not sufficiently productive in western Oregon and Washington to be recommended.

For fall seeding in the Willamette Valley the Winter Turf (Oregon Gray Winter) is chiefly grown. This variety is identical with the Winter Turf oat grown in the northern portion of the winter-oat belt of the Southeastern States. It is the most typical winter variety known in the United States. The plant grows rather tall and has narrow dark-brown leaves. Under the favorable climatic conditions in western Oregon this variety ordinarily produces an excellent quality of grain. Although the kernels are gray, they are clean and bright.

VARIETIES FOR CALIFORNIA

Oat culture in California is limited almost entirely to the varieties of the red-oat group (*Avena byzantina*). White or northern oats are poorly adapted and can not be recommended, except possibly in northern California. The adaptation of the so-called warm-climate varieties, such as Red Rustproof, Fulghum, and Burt, has made oat production possible in California.

The Red Rustproof (California Red) variety has been standard in California for years. It is the most extensively cultivated and widely adapted oat in the State. In recent years Fulghum and Kanota have become popular. Varietal experiments conducted at University Farm, Davis, Calif., indicate that the Fulghum strains (including Kanota) are superior to those of the California Red. The earliness of Fulghum apparently enables the crop to escape some heat and drought damage. Results so far obtained from the Fulghum oat on farms and in experimental plots indicate that the variety should be strongly recommended for that State. A field of Fulghum oats in California is shown in Figure 11.

In the north-central coast district of California the Coastblack variety also is grown. This black oat has a very long growing period. It belongs, however, to the so-called red-oat group (*Avena byzantina*). In all kernel characters other than color it is similar to the Red Rustproof (California Red). It is distinct, however, in its adaptation. It is taller and of later maturity and produces grain of poorer quality. Both the Red Rustproof (California Red) and Coastblack are grown rather extensively in California for hay.

OATS FOR HAY

A considerable acreage of oats is cut for hay in the western half of the United States, especially in the Pacific area, where they produce heavy hay yields. Because of seasonal developments of weather or markets, oats sown for seed purposes often are harvested for hay. When sown especially for hay purposes oats frequently are grown in combination with peas, common vetch, or Hungarian vetch. Oats intended for hay should be cut in the soft-dough stage. When cut at this stage and properly cured, oats make a very palatable and highly nutritious hay which is relished by all classes of livestock. The addition of peas or vetch usually increases the yield of hay and improves its quality.

Cultural methods for growing oat hay are similar to those described for grain production. When sown in combination with peas, a common proportion is 5 to 6 pecks of oats and 4 to 6 pecks of peas, sowing the mixture at the rate of 10 to 12 pecks to the acre. For the oats-vetch mixture the proportion is 6 to 8 pecks of oats and 60 pounds of common vetch or Hungarian vetch.

Hay from oats alone or from oats grown in combination with other crops is cut and cured similarly to other hay. Curing in the windrow or cock is a common practice.

The varieties of oats commonly grown for grain in most sections, as a rule, are the most satisfactory for hay. In sections where both the short-strawed early and the taller midseason varieties are grown, the latter usually are preferable because of the heavier yield of forage or straw.

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